Patent Claims

1. A method for verifying the authenticity of an image recorded in a person identifying process and belonging to a person to be identified, the method comprising the steps of:

   recording a sequence of consecutive individual images of the person, and

   determining the authenticity of the recorded image if in at least two consecutive individual images of the sequence intrinsic movements are detected.

2. The method according to claim 1, wherein determination of the intrinsic movements comprises evaluating at least one differential image of two consecutive individual images of the sequence.

3. The method according to claim 2, wherein for the determination of the intrinsic movements a differential image is evaluated that results from an AND operation of two consecutive differential images.

4. The method according to claim 2, wherein each differential image is binarized prior to evaluation.

5. The method according to claim 4, wherein binarization is carried out by means of a threshold value which is determined by evaluating the background.

6. The method according to claim 2, wherein in each differential image at least one section of enhanced movement is selected, and

   intrinsic movements are detected if said at least one section in the differential image is consistent with a predetermined region in which intrinsic movements are to be expected.

7. The method according to claim 6, wherein the section of enhanced movement has a vertical and a horizontal extent.

wherein the vertical extent is substantially determined by a peak of the function of the products from the horizontal projections with the horizontal variances of the differential image, and

the horizontal extent is substantially determined by a peak of the function of the products from the vertical projections with the vertical variances of the differential image.

8. The method according to claim 7, wherein each function is smoothed with a low-pass filter prior to the determination of the corresponding peak.

9. The method according to claim 6, wherein sections are chosen from the differential image that are expected to have a symmetrical relationship with one another, and

intrinsic movements are detected when the symmetrical relationship is verified by a correlation analysis of the corresponding sections.

10. The method according to claim 6, wherein intrinsic movements are detected if it is determined by way of a correlation analysis that the enhanced movement in the region of enhanced movement is irregularly distributed over said region.

11. The method according to claim 2, wherein detection of intrinsic movements further comprises evaluating:

a function which depends on the vertical position and which is determined for a given vertical position through the product from the horizontal projection with the horizontal variance of the differential image, and

a function which depends on the horizontal position and which is determined for a given horizontal position through the product from the vertical projection with the vertical variance of the differential image.

12. The method according to claim 11, wherein each function is smoothed with a low-pass filter.

13. The method according to claim 11, wherein

at least one peak is determined in the function depending on the vertical position, and at least one peak is determined in the function depending on the horizontal position, and

intrinsic movements are detected if said peaks in the vertical and horizontal direction are within predetermined limits that are given by the vertical and horizontal extent of at least one region in which intrinsic movements are to be expected.

14. The method according to claim 11 further comprising evaluating,

on the basis of the function depending on at least one of the vertical position and the function depending on the horizontal position, sections that are expected to be in a symmetrical relationship, and

detecting intrinsic movements if the symmetrical relationship is verified by a correlation analysis of the corresponding sections.

15. The method according to claim 14, wherein the sections which are expected to be in a symmetrical relationship are standardized with respect to each other prior to the correlation analysis.

16. The method according to claim 11 further comprising evaluating at least one of

the function depending on the vertical position and the function depending on the horizontal position, and

detecting intrinsic movements if it is determined by way of a correlation analysis that the values of at least one of the function depending on the vertical position and of the function depending on the horizontal position are irregular over a predetermined region.

17. The method according to claim 1, wherein the intrinsic movements to be determined are intrinsic movements in the head region of the person to be identified.

18. The method according to claim 17, wherein the intrinsic movements to be determined are intrinsic movements in at least one of the group consisting of the mouth region, the cheek region, the nose region, and the eye region of the person to be identified.

19. The method according to claim 17, wherein the intrinsic movements to be determined are intrinsic movements in at least two regions that are in symmetrical relationship with each other in the head region of the person to be identified, and said at least two symmetrical regions are used for determining the axis of symmetry of the head region.

20. The method according to claim 19, further comprising producing with the help of the axis of symmetry found, an image which can be used for identifying a person and in which a frontoparallel-rotated head region is transformed into a head region with a rotated axis of symmetry.

21. The method according to claim 19, further comprising producing an image of the person to be identified with the help of the axis of symmetry found, said image being useable for identifying the person and being composed of the left head region and the mirrored left head region or of the right head region and the mirrored right head region.

22. The method according to claim 1, further comprising prior to the detection of the authenticity extracting regions from the individual images in which intrinsic movements are expected.

23. The method according to claim 22, wherein extracting the regions comprises evaluating at least one differential image of two consecutive individual images of the sequence.

24. The method according to claim 23, wherein extracting the regions comprises evaluating a differential image that results from an AND operation of two consecutive differential images.

25. The method according to claim 23, wherein each differential image is binarized prior to evaluation.

26. The method according to claim 25, wherein binarization is carried out by means of a threshold value which is determined by evaluating the background.

27. The method according to claim 22, wherein the head region of the person to be identified is extracted.

28. The method according to claim 27, wherein the extracted head region for identifying the person is transformed to a predetermined standard size.

29. The method according to claim 27, wherein extracting the head region comprises determining at least two head boundaries in the corresponding individual images, on the basis of which the head region is extracted from the corresponding individual images.

30. The method according to claim 29, wherein determining the head region in the corresponding individual images comprises determining the upper and the left head boundary.

31. The method according to claim 29, wherein determining the head boundary in the corresponding individual images comprises determining the upper, the left and the right head boundary.

32. The method according to claim 29, wherein each head boundary is defined by a head boundary line which extends such that the contour of the head is positioned substantially entirely within the head boundary lines.

33. The method according to claim 30, wherein for the determination of the upper head boundary comprises:

determining a function of the vertical projections of a binarized differential image, and

defining the upper head boundary by the first maximum of the absolute value of the first derivative of said function that is above a predetermined threshold value.

34. The method according to claim 33, wherein the function of the vertical projections is smoothed with a low-pass filter prior to defining the head boundary.

35. The method according to claim 30, wherein determination of the left head boundary comprises:

determining a function of the horizontal projections of a binarized differential image, and

defining the left head boundary by the first maximum of the absolute value of the first derivative of said function that is above a predetermined threshold value.

36. The method according to claim 30, wherein determination of the left head boundary comprises:

dividing a binarized differential image into a plurality of vertically successive strips, the first strip being vertically downwardly adjacent to the upper head boundary determined,

determining in each strip the function of the horizontal projections of the binarized differential image,

forming the absolute values of the first derivatives of the resulting plurality of functions of the horizontal projections,

adding the sum of the resulting plurality of absolute values, and

defining the left head boundary as the first maximum of said sum that is above a predetermined threshold value.

37. The method according to claim 35, wherein the function or functions of the horizontal projections is/are smoothed with a low-pass filter prior to defining the head boundary.

38. The method according to claim 30, wherein determination of the right head boundary comprises:

determining a function of the horizontal projections of a binarized differential image, and

defining the right head boundary by the last maximum of the absolute amount of the first derivative of said function that is above a predetermined threshold value.

39. The method according to claim 30, wherein determination of the right head boundary comprises:

dividing a binarized the differential image into a plurality of vertically successive strips, the first strip being vertically downwardly adjacent to the upper head boundary determined,

determing in each strip the function of the horizontal projections of the binarized differential images,

forming the absolute values of the first derivatives of the resulting plurality of functions of the horizontal projections,

adding the sum of the resulting plurality of absolute values, and

defining the right head boundary as the last maximum of said sum that is above a predetermined threshold value.

40. The method according to claim 38, wherein the function or functions of the horizontal projections is/are smoothed with a low-pass filter prior to defining the head boundary.

41. The method according to claim 29, wherein two consecutive individual images are only used for determining the head boundaries if a change between the two consecutive individual images is within a predetermined range.

42. The method according to claim 41, wherein determination of the change between two consecutive individual images includes calculating a motional intensity.

43. The method according to claim 42, wherein the motional intensity is substantially calculated through the sum of the gray level of a differential image obtained from the two consecutive individual images.

44. The method according to claim 42, wherein the motional intensity is substantially calculated through the sum of the 1 pixel or 0 pixel of the binarized differential image.

45. The method according to ~~any one of claims 29 to 44~~ claim 29, wherein predetermined head boundaries are used for extracting the head region if no head boundaries can be determined.

46. The method according to claim 29, wherein predetermined head boundaries are used for extracting the head region if one of the head boundaries determined is not within predetermined limits.

47. The method according to claim 30, wherein one of the lower and the right and lower head boundary is defined such that a square head region is extracted from at lest one of the corresponding individual images and differential images.

48. The method according to claim 1, wherein a stabilized differential image is formed from two consecutive individual images, said image being evaluated for one of detecting the intrinsic movements and extracting the regions in which intrinsic movements are to be detected.

49. The method according to claim 48, wherein stabilization is carried out by means of a correlation correction.

50. The method according to claim 49, wherein the correlation correction comprises template matching.

51. The method according to claim 50, wherein template matching comprises calculating a differential image, the first individual image used for forming the differential image being shifted in the calculation of the differential image with respect to the second individual image used for forming the differential image in such a manner that a correlation function between the two individual images is maximum.

52. The method according to claim 12, wherein two consecutive individual images are only used for determining the intrinsic movements if a change between the two consecutive individual images is within a predetermined range.

53. The method according to claim 52, wherein a motional intensity is calculated for determining the change between two consecutive individual images.

54. The method according to claim 53, wherein the motional intensity is substantially calculated through the sum of the gray level of the differential image.

55. The method according to claim 53, wherein the motional intensity is substantially calculated through the sum of the 1 pixel or 0 pixel of the binarized differential image.